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PREDICTING SITE INDEX IN YOUNG BLACK WALNUT PLANTATIONS

Craig K. Losche and Richard C. Schlesinger

Soil Scientist and Silviculturist,
Forestry Sciences Laboratory, Carbondale, Illinois

ABSTRACT.--Prediction of black walnut height at age 25 is graphically presented for two soil-site groups. The landowner or manager can use this growth prediction to assess the productivity of young black walnut plantations.

OXFORD: 541:182.51:176.1. *Juglans nigra.*
KEY WORDS: *Juglans nigra*, forest management, height prediction, soil-site, site quality

To get maximum benefits from growing black walnut, landowners should concentrate their efforts on the most productive land. Although guidelines are available for selecting the best available land when there are no walnut trees on the area, (Losche 1970, 1973, Losche *et al.* 1972) measuring the trees themselves to assess an area's productivity is preferred, when stand conditions permit. Site index curves for black walnut have been presented by Kellogg (1939) for plantations older than 25 years from data collected in the prairie area of Iowa to Indiana. The present paper presents graphs for predicting mean height at age 25, using measured height at some younger age. The predicted height at 25 years (site index) can be used to compare the productivity of several areas for black walnut.

DEVELOPING THE GRAPHS

Height and age data were obtained from 255 black walnut trees removed from 25- to 30-year-old unmanaged plantations located in southern Illinois (Table 1). Three to five representative overstory trees, approximately equal in height, diameter, and spacing, were selected on each of 60 plots--45 plots on a floodplain and 15 on upland landscapes. These plantations were established on National Forest lands with seed and seedlings planted at either 4- by 4- or 6- by 6-foot spacing. The plots were uniform in vegetation, topography, and soil. Thin disks were cut from each tree at 1-foot intervals from ground level to 5 feet and then at 2-foot intervals to the top for age determinations.

Mean heights of the sample trees for each plot at 5 years and at each 2-year interval thereafter were used, by means of regression analysis, to develop and test equations for predicting height at 25 years. Based on previous information (Losche 1973) and the results of these analyses, the data were separated into two groups: (1) *shallow floodplain soils* (having a distinct gravel layer within 40 inches of the surface), and (2) *deep floodplain soils* (not having a distinct gravel layer within 40 inches of the surface) *and upland soils.*

Table 1.--*Number of plots and trees sectioned from each soil group within each height class*

Height class (height at 25 yr) (ft)	Floodplain				Upland[1]		All	
	Shallow (<40" to gravel)		Deep (40"+ to gravel)					
	Plots	Trees	Plots	Trees	Plots	Trees	Plots	Trees
15 to 25	3	14					3	14
25 to 35	9	40	2	8	3	14	14	62
35 to 45	5	22	4	17	5	20	14	59
45 to 55	2	9	9	39	5	20	16	68
55 to 65			11	44	2	8	13	52
Total	19	85	26	108	15	62	60	255

[1] Miscellaneous group of plots located on a variety of upland slope positions and aspects with too few in any one topographic situation to group separately.

Site index predictions have historically been obtained from families of curves describing the relation between height and age for site index classes. As indicated by Curtis, *et al.* (1974) a more accurate prediction of site index is obtained using equations describing the relation between site index and height for specific ages. Therefore, this approach was followed and the equations are presented as a family of curves for age classes from 5 to 25 years at 2-year intervals (figs. 1 and 2).

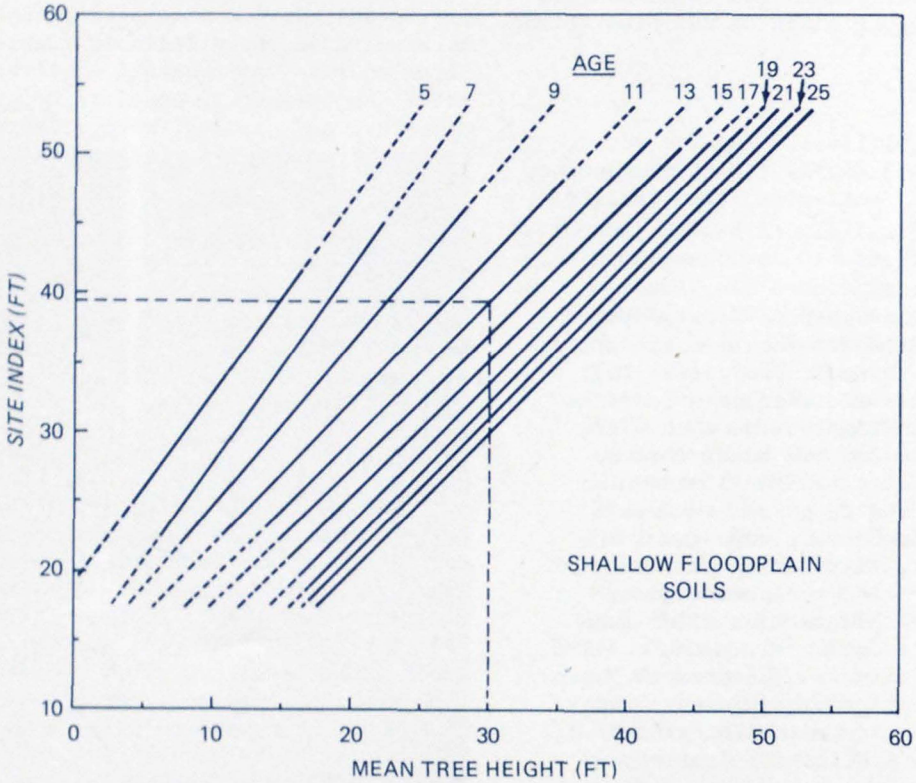

Figure 1.--*Relation of measured height and age to site index (height, in feet, at 25 years) for* shallow floodplain soils. *Solid portion of lines show extent of data.*

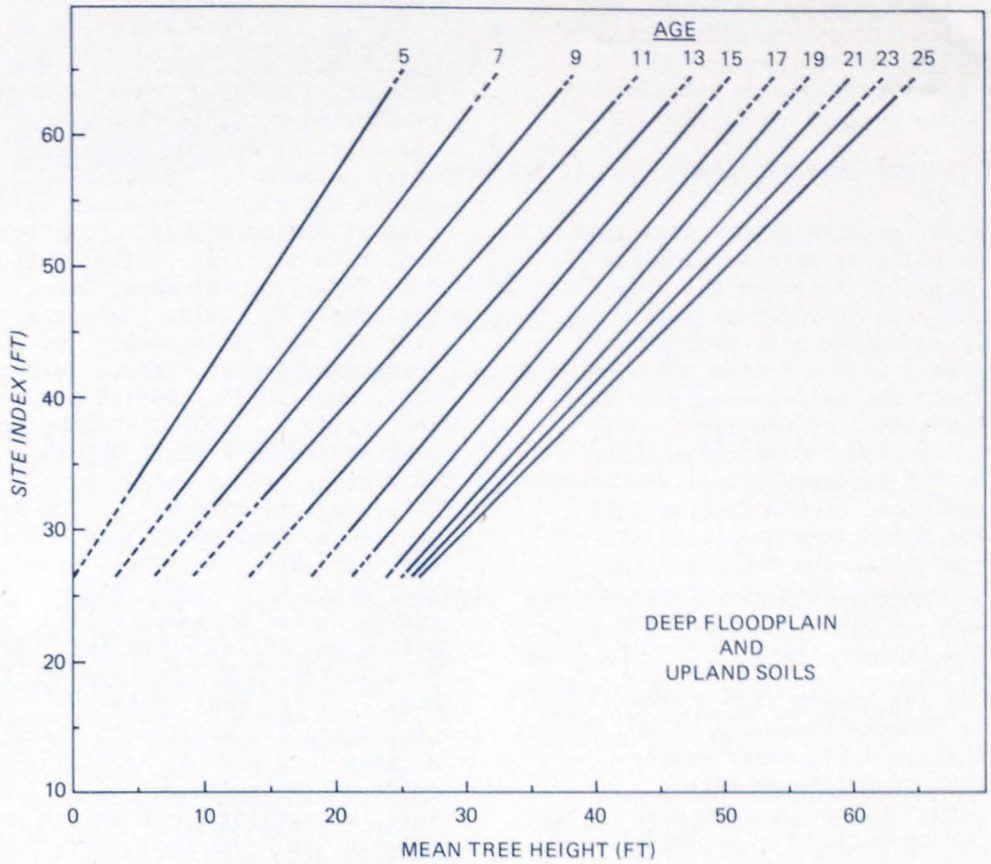

Figure 2.--*Relation of measured height and age to site index (height, in feet, at 25 years) for* deep floodplain and upland soils. *Solid portion of lines show extent of data.*

USING THE GRAPHS

The regression analyses showed that the index values could be predicted with a linear equation using the heights at a specific age. Separate equations were derived for odd-numbered plantation ages, 5 through 23 years, for each soil group (figs. 1 and 2).

To estimate the site index for a specific plantation:

1. Determine whether the plantation is on a floodplain or upland site and whether a distinct gravel layer exists within 40 inches of the surface.

2. Find the mean heights of 3 to 5 representative overstory trees that are similar in height, diameter, and spacing and occur on the same soil.

3. Determine plantation age, from planting records or ring counts of stumps left after thinning.

4a. Refer to *figure 1* if the plantation is on a shallow floodplain soil.

4b. Refer to *figure 2* if the plantation is on a deep floodplain or an upland site.

5. Locate the mean height on the horizontal axis of the appropriate figure, read straight up to the slanted line corresponding to the plantation age, and then read the site index value on the vertical

axis. For example, a plantation on shallow floodplain soil with a mean height of 30 feet and 13 years old would have an estimated site index of 39 (see figure 1).

LIMITATIONS OF THE GRAPHS

Predictions for plantations less than 5 years old or using heights outside the range of our data (as shown on the graphs) should be considered only tentative. One-third of the predictions made from heights at age 5 were more than 6.6 feet off. However, by age 13 the errors should be less than 5 feet two-thirds of the time. Only 15 plots were measured in the uplands, so these data may not adequately represent the growth conditions of the diverse soil and topographic situations of upland sites. Further, because data were obtained from unmanaged plantations, estimates for managed plantations, if the management has affected height growth, will also be in error.

As long as the limitations of the sample and the inherent accuracy of the relations are recognized, these graphs will provide the practitioner with a measure for comparing two or more plantations and for assessing the potential productivity of a plantation.

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